

NON-PUBLIC?: N
ACCESSION #: 9401070142
LICENSEE EVENT REPORT (LER)

FACILITY NAME: HOPE CREEK GENERATING STATION PAGE: 1 OF 5

DOCKET NUMBER: 05000354

TITLE: Engineered Safety System Actuation - Manual reactor scram
due to severe arcing on main generator exciter brush
assembly.

EVENT DATE: 12/01/93 LER #: 93-012-00 REPORT DATE: 12/30/93

OTHER FACILITIES INVOLVED: DOCKET NO: 05000

OPERATING MODE: 1 POWER LEVEL: 100

THIS REPORT IS SUBMITTED PURSUANT TO THE REQUIREMENTS OF 10 CFR
SECTION:
50.73(a)(2)(iv)

LICENSEE CONTACT FOR THIS LER:

NAME: Louis Aversa, Senior Staff TELEPHONE: (609) 339-3386
Engineer - Technical

COMPONENT FAILURE DESCRIPTION:

CAUSE: SYSTEM: COMPONENT: MANUFACTURER:
REPORTABLE NPRDS:

SUPPLEMENTAL REPORT EXPECTED: NO

ABSTRACT:

On Tuesday, November 30, 1993, at 2100 hours, the equipment operator (NEO -nonlicensed) performing routine equipment inspections noticed sparking on the main generator exciter brushes. The nuclear shift supervisor (NSS - SRO licensed) and shift electrician were notified and inspected the exciter brushes both confirming that the sparking was excessive and immediate corrective actions were required. Additional off-duty personnel from system engineering and maintenance were called in to determine the cause of the sparking and whether the brush change should be attempted. After verifying normal current readings on the collector ring, it was determined that the brush was worn and replacement should be attempted. When the electrician pulled the brush assembly the remaining brushes on that ring began to spark violently. An immediate recommendation was made by system engineering to take the

generator off line. Control room personnel were notified who reduced reactor recirculation flow to minimum and inserted a manual scram. All immediate operator actions following the scram were appropriate and all plant systems functioned normally. The root causes of this event were attributed to inadequate inspection guidelines and different style brushes being supplied by the vendor under the same part number. Corrective actions include revising the monthly inspection procedure, performance of additional weekly inspections and removing the incorrect style brushes from stores.

END OF ABSTRACT

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PLANT AND SYSTEM IDENTIFICATION

General Electric - Boiling Water Reactor (BWR/4)
Reactor Protection System (SB) EEIS Identifier JC
Main Generator and Exciter (MG) EEIS Identifier TL

IDENTIFICATION OF OCCURRENCE

TITLE (4): Engineered Safety System Actuation - Manual reactor scram due to severe arcing on main generator exciter brush assembly.

Event Date: 12/01/93

Event Time: 0050

This LER was initiated by Incident Report No. 93-121

CONDITIONS PRIOR TO OCCURRENCE

Plant in OPERATIONAL CONDITION 1 (Power Operation)
Reactor Power 100% of rated, 1110 MWe.

DESCRIPTION OF OCCURRENCE

On Tuesday, November 30, 1993, at 2100 hours, the equipment operator (NEO -nonlicensed) performing routine equipment inspections noticed sparking on the main generator exciter brushes. The nuclear shift supervisor (NSS - SRO licensed) and shift electrician were notified and inspected the exciter brushes both confirming that the sparking was excessive and immediate corrective actions were required. The maintenance department senior electrical supervisor was contacted at home and apprised of the situation. He stated that although the exciter brushes have never been changed with the unit on line, the equipment

design does permit the brushes to be changed during operation. Additional off-duty personnel from system engineering and maintenance were called in to determine the cause of the sparking and whether the brush change should be attempted. After verifying normal current readings on the collector ring, it was determined that the brush was worn and replacement should be attempted. The electric load dispatcher was contacted and allowed generator VAR loading to be reduced to reduce current on the brushes. After a pre-job briefing in the main control room the electrician, electrical supervisor and system engineer proceeded to the exciter brush compartment. When the electrician pulled the brush assembly the remaining brushes on that ring began to spark violently. An immediate recommendation was made by system engineering to take the generator off line. Control room personnel were notified who reduced reactor recirculation flow to minimum and inserted a manual scram. All immediate operator actions following the scram were appropriate and all plant systems functioned normally.

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ANALYSIS OF OCCURRENCE

The main generator exciter brush assembly consists of two collector rings with one brush at the 9, 12, and 3 o'clock positions on each ring. Each brush is set in an individual cartridge which holds the brush in position and provides the force via a spring assembly to hold the brush against the collector ring. The brush is connected electrically to the cartridge via a braided wire pigtail. During brush changeout the entire cartridge is removed, the brush is replaced and the cartridge reinstalled.

Personnel involved in the assessment of whether or not to replace the sparking brush determined that the risk of replacing the one brush was low versus the risk associated with continued operation. The brush apparently had been sparking for a short period of time as the equipment operator who inspected the exciter compartment on the previous shift did not see any signs of sparking at the brushes. Visual inspection of the remaining two brushes on the ring did not reveal any abnormalities and the current reading on the ring was consistent with current plant conditions. Although the exciter brushes had not been previously changed at power, the design did permit such action and similar brush changeouts are performed frequently on similar equipment (recirc motor-generator sets). When the brush cartridge was removed unexpected sparking and arcing occurred (first on one brush and approximately 4 minutes later on the remaining brush), a decision was made to remove the unit from service based on equipment and personnel safety.

A Significant Event Response Team (SERT) was convened to determine the root cause of the failure. The subsequent investigation determined the brush had lost contact with the collector ring as a result of the pigtail, which is used to attach the brush to the cartridge, interfering with the free movement of the brush. The subsequent sparking caused overheating and deterioration of the collector ring surface. When the brush was removed the remaining two brushes began to spark and arc.

A previous occurrence of a turbine generator trip from a brush failure was reported in 1988. At that time extensive damage to the collector ring and brushes resulted in an indeterminate root cause of the failure. Corrective actions were to prepare a procedure detailing the brush inspection requirements and increasing the frequency of the inspection to weekly. The monthly inspection frequency was changed to weekly following the event. When the procedure was approved in 1990, it was decided to return the inspection frequency to monthly.

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ANALYSIS OF OCCURRENCE (Con't)

The ongoing investigation of this event has identified problems associated with the inspection requirements, and replacement brushes as the primary root causes of this event. Two types of inspections are performed, a shiftly inspection by operations personnel who are looking for indications of unpredictable type failures and a maintenance department inspection which monitors for normal wear and replacement requirements. The maintenance inspection procedure identifies specific values for acceptable brush length and replacement is then scheduled based on the inspection results. The procedure did, however, contain some ambiguous directions such as "check for unusual sparking" which could be interpreted as some amount of sparking is normal. Other steps required maintenance personnel to take action if "a change from normal appearance" was noted on collector ring surface and other components. Wear was based on the length of the brush remaining above the cartridge. If brush movement was restricted and lost contact with the shaft it would no longer wear and its position relative to the cartridge would not change.

The brushes were also identified as a primary root cause of the event as three separate style brushes were approved for use. All brushes did carry the same part number from the vendor and were similar in respect to composition and hardness; however, three different pigtail connection styles were noted. On one style the braided wire was connected on each side of the brush, while another style had both braided wires connected on the same side of the brush. The preferred style had both braided

wire terminations located between the sides of the brush leaving the sides free of any obstructions. The cartridge which holds the brush in place does accept all three styles; however, the brushes with the side mount pigtails do run a greater risk of hanging up on the edge of the cartridge as the brush wears and travels further down the cartridge. The center mount pigtails provide greater clearance between the pigtail and cartridge sides allowing the brush to travel deeper into the cartridge. The acceptance criteria for brush length is based on assumed free travel into the cartridge and did not account for the side mount pigtail interfering with the brushes travel. The different style brushes are identified via the same part number with the only difference being noted is manufacturer codes identifying separate divisions of General Electric Company which supply the brushes. The purchasing department is currently investigating why different style parts were listed under the same part number.

APPARENT CAUSE OF OCCURRENCE

The root cause of this event is that preventive maintenance procedures and inspections were inadequate to detect brush degradation with sufficient time to correct a problem before gross failure.

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PREVIOUS OCCURRENCES

As stated above, one previous occurrence of a similar type failure has been reported (see LER 88-029-00). The root cause investigation of the previous failure did not identify the conditions noted in this event.

SAFETY SIGNIFICANCE

This incident posed minimal safety significance as all systems functioned as required.

CORRECTIVE ACTIONS

1. The exciter collector ring has been repaired and all exciter brushes were replaced with the preferred pigtail design.
2. Planning and procurement are taking action to ensure only the preferred style brush is available for replacement.
3. The monthly inspection procedure is being revised to modify specified limits for brush length, inclusion of a pictogram of the

preferred brush style and eliminate ambiguity.

4. Brush inspection frequency has been increased to two times per week. A new procedure is being developed which will provide improved guidance for the new inspection.

5. The ability to perform exciter brush changeouts on line will be verified at the next scheduled unit shutdown.

Sincerely,

R. J. Hovey
General Manager -
Hope Creek Operations

LLA/

SORC Mtg. 93-67
Recommended approval: Yes

ATTACHMENT TO 9401070142 PAGE 1 OF 1

PSE&G

Public Service Electric and Gas Company
P.O. Box 236 Hancocks Bridge, New Jersey 08038

Hope Creek Generating Station

December 30, 1993

U. S. Nuclear Regulatory Commission
Document Control Desk
Washington, DC 20555

Dear Sir:

HOPE CREEK GENERATING STATION
DOCKET NO. 50-354
UNIT NO. 1
LICENSEE EVENT REPORT 93-012-00

This Licensee Event Report is being submitted pursuant to the requirements of 10CFR 50.73 (a)(2)(iv).

Sincerely,

R. J. Hovey
General Manager -
Hope Creek Operations

LAA/

Attachment
SORC Mtg. 93-67
C Distribution

The Energy People

*** END OF DOCUMENT ***
